

REMARKS

In view of the Office Action and the restriction/election requirement, claims 1, 2, 5-8, 12, 14, 20-21, 25, 30, and 32 are pending, and claims 4, 9, 15-19, 22-24, 26-27, and 31 have been withdrawn without prejudice and while preserving applicant's right to rejoin upon allowance of a generic claim. Favorable re-consideration is requested.

In response to the objection to the Abstract, applicant has amended the Abstract as set forth in the attached sheet containing a substitute Abstract. Applicant submits that this action renders the objection moot.

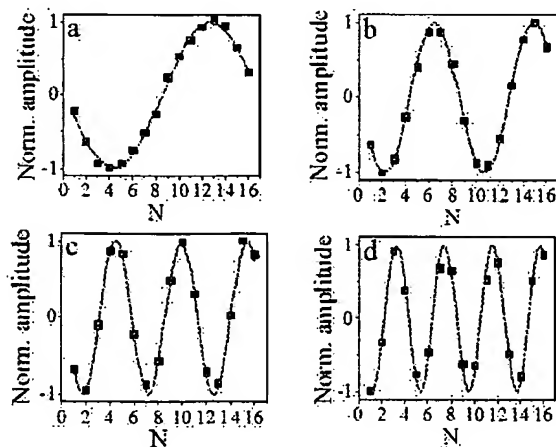
In response to the rejection of claim 32 under Section 112, first paragraph, as allegedly failing to comply with the written description requirement, applicant traverses the rejection for at least the following reasons. The Office Action contends that the claim language "wherein the apparatus is adapted such that the antenna has a sinusoidal current distribution in function of the azimuthal angle" is not supported by the specification. Applicant respectfully disagrees because the quoted claim language is supported by the specification, e.g., at page 3, lines 14-15. As a result, the claim language complies with Section 112.

Claim 30 stands rejected under Section 112, second paragraph, as allegedly being indefinite. In line with the helpful comments of the Examiner, claim 30 has been amended to correct a typographical error. Applicant submits that the claim amendment renders the rejection moot.

Claim 32 stands rejected under Section 112, second paragraph, as allegedly being indefinite. In this regard, the Office Action asks what is meant by the claim 32 language that reads: "wherein the apparatus is adapted such that the antenna has a sinusoidal current distribution in function of the azimuthal angle." In response, applicant notes the following for

the benefit of the Examiner, and as those of skill in the art know from normal experience and reading the specification/figures. As confirmed from the following and the specification/figures, claim 32 complies with Section 112; thus, applicant requests the withdrawal of the rejection.

The antenna described in the quoted phrase is a resonant circuit which presents several resonant frequencies. An antenna composed of N legs will exhibit $N/2$ resonant frequencies if the antenna is “closed” (see fig 1) and $(N-1)$ resonant frequencies if it is “open” (see fig. 6). When the antenna is excited at one of its resonant frequencies, a sinusoidal distribution of current amplitude is generated within the antenna legs. The figures below show some measurements of the current amplitude as a function of the legs number that applicant has made on a 16 leg closed antenna for the four highest resonant frequencies. With the legs beings regularly distributed on a cylinder, we have a direct correspondence between azimuthal angles and leg numbers, which justifies the wording used in the claim, as those of skill in the art can readily appreciate.



Currents distribution in a 16 leg closed antenna for mode $m=1$ (a), $m=2$ (b), $m=3$ (c) and $m=4$ (d). The horizontal axis corresponds to the legs number. Dots: measurements; lines: sinusoidal fits.

The following prior art rejections have been lodged against the claims. Each of these rejections is based upon the primary reference of Bennett (U.S. Patent 6,495,963).

1. On pages 4-6 of the Action, claims 1-2, 5, 8, 12, 21, 25, and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bennett, U.S. Patent 6,495,963 in view of Campbell et al, U.S. Patent 4,990,229 and Kwon et al, U.S. 2002/0189763 or Howald et al, U.S. Patent 6,441,555.
2. On pages 6-7 of the Action, claims 6 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bennett, U.S. Patent 6,495,963 in view of Campbell et al, U.S. Patent 4,990,229 and Kwon et al, U.S. 2002/0189763 or Howald et al, U.S. Patent 6,441,555 as applied to claims 1-2, 5, 8, 12, 21, 25, and 32 above, and further in view of Saito et al, U.S. Patent 5,728,253 or Durr, U.S. Patent 5,180,949.
3. On pages 7-8 of the Action, claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Bennett, U.S. Patent 6,495,963 in view of Campbell et al, U.S. Patent 4,990,229 and Kwon et al, U.S. 2002/0189763 or Howald et al, U.S. Patent 6,441,555 as applied to claims 1-2, 5, 8, 12, 21, 25, and 32 above, and further in view of Collins et al, U.S. Patent 6,024,826.
4. On pages 8-9 of the Action, claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Bennett, U.S. Patent 6,495,963 in view of Campbell et al, U.S. Patent 4,990,229 and Kwon et al, U.S. 2002/0189763 or Howald et al, U.S. Patent 6,441,555 as applied to claims 1-2, 5, 8, 12, 21, 25, and 32 above, and further in view of Hashimoto, U.S. Patent 6,096,232 or Okumura et al, U.S. Patent 5,888,413 or Yoshida et al, U.S. Patent 5,690,781.
5. On pages 9-10 of the Action, claim 30 is rejected under 35 U.S.C. 103(a) as being unpatentable over Bennett, U.S. Patent 6,495,963 in view of Campbell et al, U.S. Patent 4,990,229 and Kwon et al, U.S. 2002/0189763 or Howald et al, U.S. Patent 6,441,555 as applied to claims 1-2, 5, 8, 12, 21, 25, and 32 above, and further in view of Savas et al, U.S. Patent 5,811,022.

Applicant respectfully traverses the rejections because there is no prima facie case of obviousness for at least to following reasons.

A. BENNETT - USP 6,495,963

The primary reference in each of the rejections is Bennett. Bennett's WO counterpart is the fourth cited document in the International Search Report of the corresponding PCT application PCT/CH2004/000300. As properly interpreted in other patent offices, Bennett by itself or in any reasonably apparent combination with any secondary reference does not yield the claimed invention.

More specifically, it is important to note that Bennett fails to disclose many key features of claim 1:

1. *"magnetic field generators arranged around the antenna"*

As the Examiner correctly states at page 5 second paragraph of the Action, Bennett does not disclose an apparatus comprising magnetic field generators arranged around the antenna.

2. *"said antenna comprises at least two conductive loop elements"*

It is important to emphasize that an antenna is made of electric conductors which generate an electric or magnetic field, and that the antenna is supplied by supply conductors. The supply conductors do not generate any electric or magnetic field, so that they are not part of the antenna.

In contrast to the claimed invention, Bennett discloses, in figures 9-13 and their descriptions, an antenna comprising only one conductive loop, namely, the loop (coil 13) constituted by a plurality of coil portions (13a). The coil portions 13a constitute a single coil - see column 3 lines 56, 57. The electric current flowing in any part other than the segments of coil 13a is balanced by a current flowing in an opposite sense in an adjacent part, so that they do not generate any electric or magnetic

field - see column 1 lines 27-30. As a result, the parts other than the segments 13a are supply conductors, and are not part of the antenna:

- for instance, in figure 9, the leads 14a and 14b are “*input lead and output lead*” (column 4 line 14), the lines 16 are “*feed lines*” (column 4 line 15),
- in figures 11 and 12, the rings 12a and 12b are “*connecting rings*” (see column 5 lines 8-12), and are not parts of the antenna: opposite currents will flow in the rings, the currents are balanced, and the rings do not generate any electric or magnetic field.

If we consider that Bennett discloses several conductive elements 13a, then each of those elements 13a is not a “*loop*,” and does not surround the common longitudinal axis.

Accordingly, Bennett fails to disclose the foregoing feature of claim 1.

3. “*spaced along a common longitudinal axis*”

In Bennett, there is only one loop element 13. Accordingly, the feature “*spaced along*” is not disclosed in Bennett.

4. “*a pair of axial conductive elements electrically interconnecting said conductive loop elements*”

In Bennett, there is only one loop element in the antenna. Accordingly, the feature “*interconnecting*” is not disclosed in Bennett. In this regard, the conductive elements (14a, 14b) cited by the Examiner are not “*axial conductive elements*” in figure 9 of Bennett. They are radial elements. In addition, the conductive elements 14a and 14b in figures 11 and 12 are feeding elements which interconnect the only one loop element of the antenna with feeding rings 12a and 12b which are not part of the antenna. Consequently, those conductive elements do not electrically interconnect several loop elements of the antenna.

5. *each loop element including at least one capacitor*

As the Examiner correctly states, Bennett fails to disclose this feature because the capacitors (18) are present in relation with the only one loop element. Furthermore, Bennett fails to disclose capacitors which are inside the conductive loop elements, and which are therefore part of the antenna. In Bennett, the capacitors are between two supply conductors, namely, 14a, 14b, and are not between the segments 13a of the antenna.

6. *The technical effects*

As demonstrated above, there are many key differences between the features of the antenna of Bennett and the features of the antenna of claim 1. These differences are important because they result in very different effects, namely, very different generated electric fields.

In the present invention, as stated in claim 1 by the feature “*for plasma generation by helicon waves*,” the sinusoidal distribution of current amplitude within the antenna legs (the axial conductive elements) results in transverse fields which can generate helicon waves in the area inside the antenna.

In contrast, in Bennett, the generated fields are not transverse, but are parallel to the longitudinal axis, as is always the case in a coil. See figure 8. Significantly, this will not generate helicon waves.

All of the foregoing deficiencies of Bennett are not overcome by the secondary references. Nor would a person skilled in the art use Bennett's apparatus and reasonably modify it to arrive at the claimed invention. Not even with improper hindsight would a person skilled in the art do so.

B. CAMPBELL - USP 4,990,229

Campbell does teach magnetic fields generators (16, 17) arranged around the antenna (15). See column 7 lines 41-44. However, Campbell fails to disclose the important claimed feature of “*a pair of axial conductive elements electrically interconnecting said conductive loop elements.*” For example,

- In figure 4, the loop elements (1, 2) are connected by only one axial conductive element (5). The conductive elements (6) are feeding elements which each connect a loop element (1 or 2) to the matching box (9) which supplies the antenna.
- In figure 5, there is only one axial conductive element (12) which connects the loop elements. The other conductive elements (13) each connect a loop element to the matching box.

As the Examiner correctly states, Campbell fails to disclose capacitors in the conductive loop elements. Accordingly, when trying to combine Bennett and Campbell, the feature of “*a pair of axial conductive elements electrically interconnecting said conductive loop elements*” is still missing.

C. KWON - US Pat Pub 2002/0189763 A1

In Kwon, the antenna is planar. As a result, Kwon fails to disclose the missing feature of any combination of Bennett and Campbell, i.e., “*a pair of axial conductive elements electrically interconnecting said conductive loop elements.*”

D. HOWALD - USP 6,441,555 B1

Howald discloses a spiral-like coil (see the abstract line 1, see figure 2) which is planar (see column 5 lines 64-65, column 30, column 11 line 50). Accordingly, Howald fails to disclose the

missing feature of a combination of Bennett and Campbell: *“a pair of axial conductive elements electrically interconnecting said conductive loop elements.”*

For at least the foregoing reasons, there is no prima facie case of obviousness. The rejections fail to show how any combination of the cited documents include all the important features of claim 1, including the feature of *“a pair of axial conductive elements electrically interconnecting said conductive loop elements.”* In this regard, Howald and Kwon show capacitors inside the loops. However, the rejections have not shown why a person skilled in the art would be encouraged or motivated to somehow adapt the capacitors of Howald or Kwon into the antenna of Bennett or a combination of Bennett and Campbell.

As demonstrated by the facts above, claim 1 is not rendered obvious by any reasonably apparent combination of the references. For at least the same reasons, the dependent claims are not rendered obvious.

Applicant submits that the application is in condition for allowance. A notice to that effect is earnestly solicited.

If the Examiner has any questions concerning this case, the undersigned may be contacted at 703-816-4009.

Respectfully submitted,

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